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ENGINEERING CHANGE NOTICE	1. ECN 643822
Page 1 of 2	Proj. ECN

2. ECN Category (mark one)	3. Originator's Name, Organization, MSIN, and Telephone No.	4. USQ Required?	5. Date
Supplemental [] Direct Revision [X] Change ECN [] Temporary [] Standby [] Supersedure [] Cancel/Void []	Brett C. Simpson, Data Assessment and Interpretation, R2-12, 373-5915	[] Yes [X] No	08/25/98
	6. Project Title/No./Work Order No. Tank 241-AX-104	7. Bldg./Sys./Fac. No. 241-AX-104	8. Approval Designator N/A
	9. Document Numbers Changed by this ECN (includes sheet no. and rev.) HNF-SD-WM-ER-675, Rev. 0	10. Related ECN No(s). N/A	11. Related PO No. N/A

12a. Modification Work	12b. Work Package No.	12c. Modification Work Complete	12d. Restored to Original Condition (Temp. or Standby ECN only)
[] Yes (fill out Blk. 12b) [X] No (NA Blks. 12b, 12c, 12d)	N/A	N/A Design Authority/Cog. Engineer Signature & Date	N/A Design Authority/Cog. Engineer Signature & Date

13a. Description of Change

13b. Design Baseline Document? [] Yes [X] No

This ECN has been generated in order to incorporate recent sample data.

14a. Justification (mark one)

Criteria Change	[X]	Design Improvement	[]	Environmental	[]	Facility Deactivation	[]
As-Found	[]	Facilitate Const	[]	Const. Error/Omission	[]	Design Error/Omission	[]

14b. Justification Details

To provide the most recent data for use in the Hanford Tank Initiative.

15. Distribution (include name, MSIN, and no. of copies)

See attached distribution.

RELEASE STAMP

DATE: AUG 26 1998

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1. ECN (use no. from pg. 1) ECN-643822

16. Design Verification Required	17. Cost Impact						18. Schedule Impact (days)	
	ENGINEERING			CONSTRUCTION				
[] Yes	Additional	[]	$	Additional	[]	$	Improvement	[]
[X] No	Savings	[]	$	Savings	[]	$	Delay	[]

19. Change Impact Review: Indicate the related documents (other than the engineering documents identified on Side 1) that will be affected by the change described in Block 13. Enter the affected document number in Block 20.

SDD/DD	[]	Seismic/Stress Analysis	[]	Tank Calibration Manual	[]
Functional Design Criteria	[]	Stress/Design Report	[]	Health Physics Procedure	[]
Operating Specification	[]	Interface Control Drawing	[]	Spares Multiple Unit Listing	[]
Criticality Specification	[]	Calibration Procedure	[]	Test Procedures/Specification	[]
Conceptual Design Report	[]	Installation Procedure	[]	Component Index	[]
Equipment Spec.	[]	Maintenance Procedure	[]	ASME Coded Item	[]
Const. Spec.	[]	Engineering Procedure	[]	Human Factor Consideration	[]
Procurement Spec.	[]	Operating Instruction	[]	Computer Software	[]
Vendor Information	[]	Operating Procedure	[]	Electric Circuit Schedule	[]
OM Manual	[]	Operational Safety Requirement	[]	ICRS Procedure	[]
FSAR/SAR	[]	IEFD Drawing	[]	Process Control Manual/Plan	[]
Safety Equipment List	[]	Cell Arrangement Drawing	[]	Process Flow Chart	[]
Radiation Work Permit	[]	Essential Material Specification	[]	Purchase Requisition	[]
Environmental Impact Statement	[]	Fac. Proc. Samp. Schedule	[]	Tickler File	[]
Environmental Report	[]	Inspection Plan	[]		[]
Environmental Permit	[]	Inventory Adjustment Request	[]		[]

20. Other Affected Documents: (NOTE: Documents listed below will not be revised by this ECN.) Signatures below indicate that the signing organization has been notified of other affected documents listed below.

Document Number/Revision	Document Number/Revision	Document Number Revision
N/A		

21. Approvals

	Signature	Date		Signature	Date
Design Authority		8-25-98	Design Agent		
Cog. Eng. B.C. Simpson	Brett Simpson	8/26/98	PE		
Cog. Mgr. K.M. Hall	Kathleen M. Hall		QA		
QA			Safety		
Safety			Design		
Environ.			Environ.		
Other J.W. Cammann	JW Cammann	8/26/98	Other		

DEPARTMENT OF ENERGY

Signature or a Control Number that tracks the Approval Signature

ADDITIONAL

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Preliminary Tank Characterization Report for Single-Shell Tank 241-AX-104: Best-Basis Inventory

Brett C. Simpson
Lockheed Martin Hanford Corp., Richland, WA 99352
U.S. Department of Energy Contract DE-AC06-87RL10930

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Key Words: Waste Characterization, Single-Shell Tank, SST, Tank 241-AX-104, Tank AX-104, AX-104, AX Farm, Tank Characterization Report, TCR, Waste Inventory, TPA Milestone M-44, Best-Basis Inventory

Abstract: This document summarizes the information on the historical uses, present status, and the sampling and analysis results of waste stored in Tank 241-AX-104. This report supports the requirements of the Tri-Party Agreement Milestone M-44-15B.

Printed in the United States of America. To obtain copies of this document, contact: WHC/BCS Document Control Services, P.O. Box 1970, Mailstop H6-08, Richland WA 99352, Phone (509) 372-2420; Fax (509) 376-4989.

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RECORD OF REVISION

(1) Document Number: HNF-SD-WM-ER-675 | Page 1

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HNF-SD-WM-ER-675
Revision 1

PRELIMINARY TANK CHARACTERIZATION REPORT FOR SINGLE-SHELL TANK 241-AX-104: BEST-BASIS INVENTORY

August 1998

Brett C. Simpson
Lockheed Martin Hanford Corporation
Richland, Washington

Prepared for
U.S. Department of Energy
Richland, Washington

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PRELIMINARY TANK CHARACTERIZATION REPORT FOR SINGLE-SHELL TANK 241-AX-104: BEST-BASIS INVENTORY

This document is a preliminary Tank Characterization Report (TCR). It only contains a revision to the current best-basis inventory (Appendix D) for single-shell tank 241-AX-104. The *Standard Inventories of Chemicals and Radionuclides in Hanford Site Tank Wastes* (Kupfer et al. 1997) describes standard methodology used to derive the individual tank best-basis inventories.

A previous version of this TCR was issued for this tank, based on an engineering assessment of waste type, process flowsheet data, early sample data, and other available information. However, current core sample analyses are available, and an interpretation of that data is required for the Hanford Tank Initiative, without requiring the entire TCR in fiscal year 1998. A finished TCR for this tank is planned to be completed in fiscal year 1999.

REFERENCE

Kupfer, M. J., A. L. Boldt, B. A. Higley, K. M. Hodgson, L. W. Shelton, B. C. Simpson, and R. A. Watrous (LMHC), S. L. Lambert, and D. E. Place (SESC), R. M. Orme (NHC), G. L. Borsheim (Borsheim Associates), N. G. Colton (PNNL), M. D. LeClair (SAIC), R. T. Winward (Meier Associates), and W. W. Schulz (W^2S Corporation), 1997, *Standard Inventories of Chemicals and Radionuclides in Hanford Site Tank Wastes*, HNF-SD-WM-TI-740, Rev. 0A, Lockheed Martin Hanford Corporation, Richland, Washington.

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APPENDIX D

EVALUATION TO ESTABLISH BEST-BASIS INVENTORY FOR SINGLE-SHELL TANK 241-AX-104

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APPENDIX D

EVALUATION TO ESTABLISH BEST-BASIS INVENTORY FOR SINGLE-SHELL TANK 241-AX-104

An effort is underway to provide waste inventory estimates that will serve as standard characterization source terms for the various waste management activities (Hodgson and LeClair 1996) at the Hanford Site. As part of this effort, an evaluation of available information for single-shell tank 241-AX-104 was performed, and a best-basis inventory was established. This work, detailed in the following sections, follows the methodology established by the standard inventory task.

D1.0 CHEMICAL INFORMATION SOURCES

Tank 241-AX-104 was most recently sampled in November 1997 to determine the composition of residual waste in this tank. Four different auger samples were taken from different locations in the tank. The samples were mechanically homogenized, subsampled, and analyzed for selected anions, cations, and radionuclides. No density measurements were obtained. These data are reported in Esch (1998), and the samples from riser 9-G will be considered the primary data source for composition information in tank 241-AX-104. The samples from riser 3-A do not appear to be tank waste, but rather contaminated debris resulting from tank corrosion, therefore this data will not be included in the derivation of inventories for this tank.

Substantial uncertainty exists with regard to the volume of waste still remaining in this tank. Reich (1997) has the most comprehensive information regarding the remaining waste volume in 241-AX-104. The current volume range for tank 241-AX-104 is 18.9 to 28.4 kL (5 to 7.5 kgal). The estimated volume used for deriving inventories in this effort was 28.4 kL (7.5 kgal).

Other sources of information regarding this tank include a previous core sample taken in September 1977 to determine the composition of the residual sludge remaining after the 1977 sluicing campaign (Starr 1977). Comprehensive chemical and solubility information was taken from this sample. This data was the basis for the previous best-basis estimates (LMHC 1998), and will be used when the current data are not sufficient. The density measurement of the waste at that time, 1.80 g/mL, will be used in calculating inventories.

Samples taken prior to 1977 are of limited value because they reflect the composition of the waste prior to the slucing campaign, and data from these efforts will not be used in developing best-basis estimates for tank 241-AX-104. The Hanford Defined Waste model (Agnew et al. 1997a) provides tank content estimates in terms of component concentrations and inventories, using process knowledge and assumptions about the physical and chemical behavior of the wastes in the tanks.

A comprehensive waste history of this tank is provided in Agnew et al. (1997b). Tank 241-AX-104 was primarily used as a plutonium-uranium extraction (PUREX) high-level process waste receiver from the third quarter of 1966 until the second quarter of 1969, followed by the receipt and transfer of various supernatants from or to other tanks. The remaining supernatant was pumped out for cesium recovery during the third quarter of 1976, while most of the sludge (196.2 kL [52 kgal]) was sluiced for strontium recovery during the second and third quarters of 1977. A second sluicing campaign was conducted during the first quarter of 1978 to remove most of the residual sludge from this tank (Rodenhizer 1987). Tank 241-AX-104 was declared an assumed leaker in 1977, with an estimated leakage volume of 30.2 kL (8 kgal). A solids volume reevaluation was made in May 1978 (Everly 1978), with interim stabilization being completed in December 1982 (Hanlon 1998).

D2.0 COMPARISON OF COMPONENT INVENTORY VALUES

In January 1993 the average sludge depth was estimated to be 6.98 cm (2.75 in.) in this tank (Swaney 1993). This depth is slightly higher than that derived from the tank farm surveillance estimate (6.48 cm [2.55 in.]), using 26.5 kL (7 kgal) as a basis (Hanlon 1998). Based on the Swaney (1993) estimate, tank 241-AX-104 contains about 28.7 kL (7.58 kgal) of waste (in the 22.9 m [75 ft] diameter, flat bottom tank). Further analysis done by Reich (1997) provides a volume range of 18.9 to 28.4 kL (5 to 7.5 kgal), because video surveillance of the tank interior indicates that the waste is irregularly distributed. All of this waste consists of dried, highly friable, sludge. For purposes of this analysis, the best-basis inventory will be developed from the high end estimate derived by Reich (1997), 28.4 kL [7.5 kgal] of sludge.

Table D2-1 provides a summary of the washed sludge analyses from the 1977 sludge sample and tank inventory estimates based on the volume and density of the sludge (26.5 kL [7 kgal] and 1.8 kg/L, respectively), together with the wash solution components. Because this sample was obtained after the 1977 sluicing campaign, and formed the basis for the initial inventory estimates, the estimates derived from this sample will be compared against estimates derived from the information in Esch (1998), and the Hanford Defined Waste model (Agnew et al. 1997a). (The chemical species are reported without change designation per the best-basis inventory convention.)

Table D2-1. Inventory Estimates for Selected Nonradioactive Components in Tank 241-AX-104. (2 Sheets)

Component	1977 sample data tank inventory estimate[a] (kg)	1997 sample data tank inventory estimate[b] (kg)	HDW total tank inventory[c] (kg)
Al	1,770	2,700	0
Ba	76.7	94.4	NR
Bi	NR	0	0
Ca	680	619	258
Cd	44.8	83.2	NR
Cl	NR	16.0	19.8
Cr	84.0	29.5	8.96
F	NR	5.16	0
Fe	7,850	13,800	4,380
La	NR	75.1	0
K	NR	6.80	4.75
Mg	111	78.3	NR
Mn	123	240	0
Na	2,030	2,200	2,450
Ni	406	745	90.4
NO_2	102	115	715
NO_3	2,020	2,340	1.01E-13
OH_{TOTAL}	11,300	19,600	4,120
Pb	NR	474	0
PO_4	276	< 27.5	0
Si	1,850	44.4	1,130
SO_4	343	242	328
Sr	NR	48.7	0
U_{TOTAL}	0.11	168	7.99
Zr	NR	202	0
TOC	NR	114	0
H_2O (wt%)	41	9.5	61.5

Table D2-1. Inventory Estimates for Selected Nonradioactive Components in Tank 241-AX-104. (2 Sheets)

Component	1977 sample data tank inventory estimate[a] (kg)	1997 sample data tank inventory estimate[b] (kg)	HDW total tank inventory[c] (kg)

NR = Not reported

[a]LMHC (1998). Data from Starr (1977), except for Na; Tank inventory based on 26.6 kL (7.03 kgal) of sludge with an average density of 1.80 kg/L

[b]Data from Esch (1998); Tank inventory based on 28.4 kL (7.5 kgal) of sludge with an average density of 1.80 kg/L

[c]Agnew et al. (1997a); Tank inventory based on 26.5 kL (7.0 kgal) of sludge with an average density of 1.34 kg/L

Table D2-2 provides a comparison of the mean sludge radionuclide tank inventory estimates based on the 1977 grab sample, 1997 auger sample, and the Hanford Defined Waste model. Radionuclide results in Table D2-2 have been decayed to January 1, 1994.

Table D2-2. Inventory Estimates for Radioactive Components in Tank 241-AX-104 (Decayed to January 1, 1994).

Component	1977 sample data tank inventory estimate[a] (Ci)	1997 sample data tank inventory estimate [b] (Ci)	Hanford Defined Waste Total tank inventory[c] (Ci)
^{60}Co	347	< 953	0.868
^{79}Se	NR	0.05	2.95
^{90}Sr	1.57E+06	2.95E+06	4.28E+05
^{90}Y	1.57E+06	2.95E+06	4.29E+05
^{99}Tc	NR	95.3	4.47
^{125}Sb	281	NR	3.90
^{137}Cs	32,400	61,600	16,500
^{137m}Ba	30,700	58,300	15,600
^{154}Eu	1,860	NR	194
^{155}Eu	1,780	NR	250
$^{239/240}$Pu	349	340	77.0
^{241}Am	NR	965	102

NR = Not reported

[a]LMHC (1998). Data from Starr (1977); Tank inventory based on 26.6 kL (7.03 kgal) of sludge with an average density of 1.80 kg/L.

[b]Data from Esch (1998); Tank inventory based on 28.4 kL (7.5 kgal) of sludge with an average density of 1.80 kg/L.

[c]Agnew et al. (1997a); Tank inventory based on 26.5 kL (7.0 kgal) of sludge with an average density of 1.34 kg/L.

D3.0 COMPONENT INVENTORY EVALUATION

Sample-based estimates developed from analytical data and HDW model estimates from Los Alamos National Laboratory (LANL) (Agnew et al. 1997a) are both potentially useful for estimating component inventories in the tank. The HDW model is mainly based on process production records and waste transaction records for each tank. Primary wastes are process wastes initially added to tank 241-AX-104 from the processing plant, while secondary wastes are transferred into the tank from another tank. A review of these records shows that tank 241-AX-104 received the following wastes (Agnew et al. 1997b):

- 7,521 kL (1,987 kgal) of primary PUREX high-level (P2) waste, most of which was later sluiced to B Plant for strontium recovery during the 1977 sluicing campaign

- 897 kL (237 kgal) of PUREX organic wash (OWW3) waste, all of which was later sluiced to B Plant for strontium recovery during the 1977 sluicing campaign because the OWW3 sludge layer was added to the top of the P2 layer

- 185 kL (49 kgal) of high-level B Plant (B) waste added in 1968 and 1969, all of which was later sluiced to B Plant for strontium recovery during the 1977 sluicing campaign

- 485 kL (128 kgal) of PUREX low-level (PL) waste, all of which was later sluiced to B Plant for strontium recovery during the 1977 sluicing campaign

- 34 kL (9 kgal) of B Plant AR vault sludge added in early 1976, all of which was later sluiced to B Plant for strontium recovery during the 1977 sluicing campaign

- Various supernatant transfers from tanks 241-A-102, 241-A-104, and 241-AX-103 from 1973 to 1976.

The HDW model (Agnew et al. 1997a) assumes that 26.5 kL (7 kgal) of PUREX high-level (P2) sludge were left in this tank after the 1977 and 1978 sluicing campaigns. The sludge inventory estimates derived from this model are consistent with the tank farm surveillance data for this tank (26.5 kL [7 kgal] of sludge) (Hanlon 1996).

D3.1 WASTE TYPES

Five different types of wastes were added to tank 241-AX-104. The most important from a volume perspective are primarily PUREX high-level (P2) waste, PUREX organic wash (OWW3) waste, and PUREX low-level (PL) waste. However, only one of these wastes, P2 waste, remains in the tank in any substantial quantity because of the sluicing campaigns that were undertaken in 1977 and 1978.

PUREX High-Level (P2) Waste

Approximately 7,521 kL (1,987 kgal) of primary PUREX high-level (P2) waste were added to this tank from 1966 to 1968. According to the HDW model, 3.9 vol% of this waste would have precipitated as sludge in the primary receiver tank (Agnew et al. 1997a). Based on this estimate, approximately 293 kL (77.5 kgal) of PUREX (P2) sludge would have precipitated in this tank from 1966 to 1968. This model also assumes that 0.6 vol% of the PUREX organic wash (OWW3) waste precipitated (in 1968), 2.2 vol% of the PUREX low-level (PL) waste (in 1968 and 1969), 0.5 vol% of the B Plant (B) waste (also in 1968 and

1969) and 3.3 vol% of the B Plant AR (AR) vault waste (in 1974). Altogether, some 311 kL (82.2 kgal) of sludge would have precipitated in this tank before the 1977 sluicing campaign, with 94 percent of this inventory consisting of PUREX high-level (P2) waste.

Anderson (1990), however, indicates that only 208 kL (55 kgal) of sludge existed in this tank before the 1977 sluicing campaign. About 196.8 kL (52 kgal) of waste were removed from this tank during the first sluicing campaign (second and third quarters of 1977) (Rodenhizer 1987). If the Agnew estimates are correct, another 88 kL (23 kgal) of sludge were apparently removed during the second sluicing campaign (first quarter of 1978), leaving 26.5 kL (7 kgal) of residual PUREX high-level (P2) waste currently in this tank.

The aqueous waste stream from the first decontamination and partitioning cycle in PUREX (HAW) is the only waste stream not recycled in the PUREX plant. This stream was the source of high-level waste from this process. The HAW stream was directed to the inorganic wash waste (1WW) concentrator where most of the nitric acid was recovered. The product stream from the 1WW concentrator was the main source of PUREX denitrated acid waste (PAW), PUREX neutralized acid waste (PNW) and in the underground storage tanks, PUREX high-level (P2) waste.

While impurity concentrations may have varied from batch to batch, the composition of the 1WW stream can be estimated from samples taken during 1958 (Van Tuyl 1958 and Allen 1976). The 1WW sample data were normalized to the amount of Fe in tank 241-AX-104 (using the 1977 data), and used to evaluate other components in this waste, because iron was present in relatively high concentration, and thus easily detected. In addition, iron is not considered to be substantially confounded with other analytes that would be introduced in subsequent waste management operations. These data also represent the average composition of this stream before sugar denitration. Sugar denitration was initially introduced into PUREX in late 1962. The 1WW composition estimates are summarized in Table D3-3, together with 1977 1WW component inventory estimates normalized to the amount of Fe in this waste, and these results compared to the more recent analyses.

Table D3-1. Comparison of 1WW Estimates to Sample-Based Estimates for Tank 241-AX-104 Waste.

Analyte	1WW composition[a] (M)	1WW-based inventory[b] (kg)	Sample-based inventory[c] (kg)	
			1977	1998
Al	0.1	1,887	1,770	2,700
Ca	NR	NR	680	619
Cr	0.01	364	84	29.5
Fe	0.2	7,850	7,850	13,800
Mn	NR	NR	123	240
Ni	0.01	411	406	745
NO_3	7.0[d]	303,600[d]	2,020	2,340
PO_4	0.01	664	276	<27.5
Si	NR	NR	1,850	44.4
Na	0.8[d]	12,861[d]	2,030	2,200
U	0.01	1,663	0.11	168

NR = Not reported
1WW = Inorganic wash waste
[a] Estimated composition of the 1WW waste before denitration (Van Tuyl 1958 and Allen 1976)
[b] Based on estimated composition of 1WW waste normalized to the amount of Fe in tank 241-AX-104 waste, using Starr (1977) as a basis
[c] Based on the estimated inventories in tank 241-AX-104 waste from Table D3-1
[d] In the denitrated 1WW stream, NO_3 would have been reduced to about 1.0M and Na to a lower value than might be indicated from neutralized PUREX wastes produced before the use of sugar denitration.

Sample-based estimates for Na, NO_3, and Ca are in good agreement with 1WW derived estimates for these components. The 1977 results were normalized to the amount of Fe observed in this waste. For other components, such as Al, Cr, PO_4, Si, and U, the level of agreement is generally poor because these components are possibly spatially heterogeneous, and thus, not well represented in the precipitated sludge layer that was sampled in tank 241-AX-104. There is no discernable trend between the sample inventory and the 1WW inventory for these components. However, with few exceptions, the 1977 and 1998 data agree reasonably well, given the constraints and uncertainties associated with each estimate.

D3.2 SUMMARY

The sample-based inventories developed for tank 241-AX-104 appear to be consistent and in good agreement with the general estimates developed for 1WW waste. Estimates developed from flowsheets, process samples (of 1WW waste) and comparable sludge samples from other tanks generally support the credibility of the sample-based estimates for tank 241-AX-104. In contrast, HDW derived estimates for this waste (in Table D3-1) appear to be low relative to sample estimates for Al, Cr, Mn, NO_3 and Ni; and high for NO_2 and water. The 1997 auger sample data, therefore, was used to generate inventory estimates for most of the chemical components in this waste. The data from the 1977 grab sample was used to supplement the more recent data, where analytes were not measured. Where neither sample provided an estimate, Agnew et al. (1997a) was used.

D4.0 DEFINE THE BEST-BASIS AND ESTABLISH COMPONENT INVENTORIES

Chemical and radionuclide inventory estimates are generally derived from one of three sources of information: (1) sample analysis and sample derived inventory estimates, (2) component inventories predicted by the HDW model based on process knowledge and historical tank transfer information, or (3) a tank-specific process estimate based on process flowsheets, reactor fuel data, essential materials records, or comparable sludge layers and sample information from other tanks.

An effort is currently underway to provide waste inventory estimates that will serve as the standard characterization data for various waste management activities. As part of this effort, a survey and analysis of various sources of information relating to the chemical and radionuclide component inventories in tank 241-AX-104 was performed, including the following:

1. Data from an auger sample obtained in 1997 (Esch 1998).

2. Data from a grab sample obtained in 1977 after the last sluicing campaign (Starr 1977).

3. Component inventory estimates provided by the HDW model (Agnew et al. 1997a).

4. Evaluation of PUREX sludge layer based on process samples (of 1WW waste), normalized to the amount of Fe in tank 241-AX-104 (Van Tuyl 1958; Allen 1976).

5. Evaluation of the estimated thermal loads provided by the sample-based inventories of ^{90}Sr and ^{137}Cs relative to a simplified heat balance for this tank. The volume range from Reich (1997) was used in quantifying the waste inventory.

Based on this analysis, a best-basis inventory was developed. The 1997 auger sample was used to generate estimates for most of the chemical and radionuclide components in this waste. This waste mostly consists of PUREX high-level waste from Al-clad fuel. The best-basis inventory for tank 241-AX-104 is presented in Tables D4-1 and D4-2. The inventory values reported in Tables D4-1 and D4-2 are subject to change. Refer to the Tank Characterization Database (TCD) for the most current inventory values.

Once the best-basis inventories were determined, the hydroxide inventory was calculated by performing a charge balance with the valences of other analytes. This charge balance approach is consistent with that used by Agnew et al. (1997a).

Best-basis tank inventory values are derived for 46 key radionuclides (as defined in Section 3.1 of Kupfer et al. 1997), all decayed to a common report date of January 1, 1994. Often, waste sample analyses have only reported ^{90}Sr, ^{137}Cs, $^{239/240}Pu$, and total uranium (or total beta and total alpha), while other key radionuclides such as ^{60}Co, ^{99}Tc, ^{129}I, ^{154}Eu, ^{155}Eu, and ^{241}Am, etc., have been infrequently reported. For this reason it has been necessary to derive most of the 46 key radionuclides by computer models. These models estimate radionuclide activity in batches of reactor fuel, account for the split of radionuclides to various separations plant waste streams, and track their movement with tank waste transactions. (These computer models are described in Kupfer et al. 1997, Section 6.1 and in Watrous and Wootan 1997.) Model generated values for radionuclides in any of 177 tanks are reported in the HDW Rev. 4 model results (Agnew et al. 1997a). The best-basis value for any one analyte may be either a model result or a sample or engineering assessment-based result if available. For a discussion of typical error between model derived values and sample derived values, see Kupfer et al. 1997, Section 6.1.10.

Table D4-1. Best-Basis Inventory Estimates for Nonradioactive Components in Tank 241-AX-104 (Effective May 30, 1998). (2 Sheets)

Analyte	Total inventory (kg)	Basis (S, M, E or C)[1]	Comment
Al	2,700	S	Starr (1977)=1,770
Bi	0	E	No process history of Bi
Ca	619	S	Starr (1977)=680
Cl	16.0	S	
TIC as CO_3	557	M/E	
Cr	29.5	S	Starr (1977)=84
F	5.16	S	
Fe	13,800	S	Starr (1977)=7,850
Hg	0	E	Simpson (1998)
K	6.80	S	
La	75.1	S	
Mn	240	S	Starr (1977)=123
Na	2,200	S	Starr (1977)=2,030
Ni	745	S	Starr (1977)=406
NO_2	115	S	Starr (1977)=102
NO_3	2,340	S	Starr (1977)=2,020
OH_{TOTAL}	19,600	C	Based on charge balance
Pb	474	S	
PO_4	276	S	Starr (1977)
Si	44.4	S	Starr (1977)=1,850
SO_4	242	S	Based on ICP. Starr (1977)=343
Sr	48.7	S	
TOC	114	S/E	Upper bounding estimate
U_{TOTAL}	168	S	Starr (1977)=0.11

Table D4-1. Best-Basis Inventory Estimates for Nonradioactive Components in Tank 241-AX-104 (Effective May 30, 1998). (2 Sheets)

Analyte	Total inventory (kg)	Basis (S, M, E or C)[1]	Comment
Zr	202	S	

[1]S = Sample-based
M = Hanford Defined Waste model-based, Agnew et al. (1997a)
E = Engineering assessment-based
C = Calculated by charge balance; includes oxides as hydroxides, not including CO_3, NO_2, NO_3, PO_4, SO_4, and SiO_3.

Table D4-2. Best-Basis Inventory Estimates for Radioactive Components in Tank 241-AX-104, Decayed to January 1, 1994 (Effective May 30, 1998). (2 Sheets)

Analyte	Total inventory (Ci)	Basis (S, M, or E)[1]	Comment
^{3}H	3.38	M	
^{14}C	0.63	M	
^{59}Ni	3.12	M	
^{60}Co	347	S	Starr (1977)
^{63}Ni	313	M	
^{79}Se	5.00E-02	S	
^{90}Sr	2.95 E+06	S	
^{90}Y	2.95 E+06	S	
^{93m}Nb	10.2	M	
^{93}Zr	13.6	M	
^{99}Tc	95.3	S	
^{106}Ru	0.0101	M	
^{113m}Cd	58.2	M	
^{125}Sb	281	S	Starr (1977)
^{126}Sn	4.61	M	
^{129}I	0.00864	M	
^{134}Cs	0.207	M	
^{137}Cs	61,600	S	
^{137m}Ba	58,300	S	Referenced to ^{137}Cs
^{151}Sm	11,000	M	
^{152}Eu	3.36	M	
^{154}Eu	1,860	S	Starr (1977)
^{155}Eu	1,780	S	Starr (1977)
^{226}Ra	1.96 E-04	M	
^{227}Ac	1.06E-03	M	
^{228}Ra	1.77 E-09	M	
^{229}Th	2.77 E-07	M	
^{231}Pa	0.00238	M	
^{232}Th	1.60 E-10	M	
^{232}U	4.67E-06	S/M	HDW isotopic normalization

Table D4-2. Best-Basis Inventory Estimates for Radioactive Components in Tank 241-AX-104, Decayed to January 1, 1994 (Effective May 30, 1998). (2 Sheets)

Analyte	Total inventory (Ci)	Basis (S, M, or E)[1]	Comment
^{233}U	1.10E-07	S/M	HDW isotopic normalization
^{234}U	5.76E-02	S/M	HDW isotopic normalization
^{235}U	2.40E-03	S/M	HDW isotopic normalization
^{236}U	1.57E-03	S/M	HDW isotopic normalization
^{237}Np	0.00954	M	
^{238}Pu	11.0	S/M	Based on ratio to ^{239}Pu
^{238}U	5.61E-02	S/M	HDW isotopic normalization
^{239}Pu	286	S/M	Based on $^{239/240}Pu$ hybrid
^{240}Pu	54.5	S/M	Based on $^{239/240}Pu$ hybrid
^{241}Am	965	S	
^{241}Pu	785	S/M	Based on ratio to ^{239}Pu
^{242}Cm	8.81E-01	S/M	Based on ratio to ^{241}Am
^{242}Pu	4.54E-03	S/M	Based on ratio to ^{239}Pu
^{243}Am	2.96E-02	S/M	Based on ratio to ^{241}Am
^{243}Cm	6.77E-02	S/M	Based on ratio to ^{241}Am
^{244}Cm	2.08	S/M	Based on ratio to ^{241}Am

[1]S = Sample-based
M = Hanford Defined Waste model-based, Agnew et al. (1997a)
E = Engineering assessment-based.

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D5.0 APPENDIX D REFERENCES

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